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Economic uncertainty and life insurance: Bayesian Network Analysis at the level of European Union

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ABSTRACT

This paper examines the relationship between economic uncertainty and the life insurance sector in the member states of the European Union (EU), with a focus on several key macroeconomic indicators, such as inflation, Gross Domestic Product growth and unemployment. Using a comprehensive dataset covering the diversity of the EU Member States over a ten-year period, econometric methods, like Bayesian Network Analysis are used to analyse the relationship between economic uncertainty indicators and life insurance performance indicators. The findings suggest a complex interplay between economic indicators and life insurance. Inflation appears as a significant factor, and unemployment, another crucial economic indicator, shows a mixed relationship in terms of life insurance demand. Therefore, in the context of an interconnected global economy, understanding how economic uncertainty influences demand for life insurance products is essential for policymakers, insurers and consumers alike.

Keywords: Life insurance, Inflation, Unemployment, Macroeconomic key indicators, European Union

1. Introduction

In a society that is in constant development and is dominated by changes, the concept of uncertainty is a phenomenon associated with the usual activities in the economy (Moore, 2017), thus affecting all its aspects from different fields of activity, political decision-makers to citizens. Economic stability and development are influenced by economic uncertainty or even by fluctuations in different key macroeconomic indicators (Zhukova, Sobolieva-Tereshchenko, 2021), such as inflation, unemployment and Gross Domestic Product (GDP) growth. This uncertainty is mostly driven by geopolitical tensions in different regions, financial market volatility, and even unexpected events, such as pandemics (Tanzi, 2022), having a profound impact not only on stability but also indirectly on demand for financial products, including life

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insurance products (Campbell, 1980). Thus, analyzing the connections between key macroeconomic indicators and the life insurance sector is essential for understanding the volatile conditions of economies and citizens well-being.

Looking at the complex perspective of the economies of the member states of the European Union (EU), uncertainty is due to the factors specific to each economy, having different economic structures, political frameworks and distinct challenges, so inflationary pressures, unemployment and GDP growth not only influence the stability and development of the region, but also the development of the life insurance sector and the perception of risks (Choudhry, Hassan, Shabi, 2020).

The main objective of this paper is to provide an overview of the relationship between economic uncertainty and the life insurance sector within the EU member states. Following the interpretation of the results obtained, the study aims to address the factors shaping the demand for life insurance in the midst of economic volatility, with a focus on the role of key economic indicators, such as inflation, GDP growth and unemployment rates.

Through a detailed analysis of the results obtained from the application of Bayesian Network Analysis on the EU member states data on the specified indicators, the article seeks to provide insights into how cultural factors and regulatory environments shape the uptake of life insurance, providing valuable implications for individuals, insurers and policymakers. Ultimately, the aim is to contribute to a deeper understanding of the complexity of decision-making in the context of economic uncertainty and to identify potential avenues for further research and policy interventions in this area.

Graphical models offer a powerful analytical framework for exploring these volatilities, providing a visual representation of the interdependencies between economic and life insurance variables. By using Bayesian Network Analysis, the links between uncertainty and insurance indicators are discovered, as well as the evaluation of policy decisions and risk management strategies.

Therefore, the paper outlines a strong overview of how economic uncertainty factors influence the life insurance sector within EU member states, highlighting the fluctuations of the indicators and the interconnection between them. This analysis provides vital information on the dynamics of the economies of the member states, useful for policymakers.

The structure of the paper is strategically organized starting with a brief approach to the existing concepts regarding uncertainties and life insurance with the help of the literature review, then the data and methodology used in the study are presented following the results, and finally conclusions and discussions.

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2. A brief literature review

Addressing the perspectives previously presented in the paper, the literature review aims to address and synthesize existing research and analysis on the complex link between economic uncertainty and the life insurance sector. By identifying prospects within member states economies, this paper creates a basis for further research under this study.

Economic uncertainty is a complex phenomenon due to various socio-economic factors (Istiak, Serletis, 2018), including the diversity of EU economies, political instability within member states, existing tensions between regions and according to Abrham and Vosta (2022), lately the effects caused by the pandemic.

According to Hammoudeh and McAleer (2015), economic uncertainty has major implications for the economies of EU member states, especially in risk management and the well-being of citizens. Okun, Fellner, Wachter (2015) state that while there are labour market fluctuations and inflationary pressures, it is essential to adopt financial strategies based on the real needs of economies, and achieving economic stability and reducing disparities between member states requires adaptability.

Unemployment is an indicator with which the influence of economic uncertainty can be identified, according to Balcilar et al. (2020), having major implications for citizens lives and risk management. Studies show that during periods of high unemployment, people prioritize financial protection, which leads to an increase in the demand for life insurance (Cristea, Dănciulescu, 2016). While people try to withstand losses caused by periods of economic uncertainty (Liebenberg, Carson, Dumm, 2012), the reduced accessibility of products in less developed countries can hinder the adoption of life insurance (Pollack, Kronebusch, 2004).

Another representative factor of economic uncertainty is inflation, which plays an important role in the stability of countries and indirectly on life insurance (Neumann, 1969). Existing studies show that inflationary pressure erodes purchasing power and living standards, thus intensifying citizens need for financial protection (Escobar, 2022), leading people to turn to life insurance. Moreover, according to Shenhav (1973), in periods of high inflation, the demand for life insurance increases, the phenomenon being due to the need for coverage against the decrease in purchasing power.

Therefore, the factors that determine the presence of the uncertainty can significantly influences life insurance in the EU member states. While empirical evidence highlights the complex interplay between economic variables and insurance adoption, further research is needed to explore specific variations across EU member states, regulatory considerations and the evolving

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consumer preference landscape. By addressing this dynamic, policymakers and insurers can better navigate uncertain environments and respond to the evolving needs of people in the EU.

3. Methodology and data

This article introduces graphical modeling techniques as a robust tool for analyzing the complex relationships between economic and life insurance variables. Graphical representations are presented to illustrate the relationships between indicators of economic uncertainty (such as inflation and unemployment) and life insurance indicators, incorporating GDP growth as a moderating factor. The results of the graphical models are interpreted, identifying the key links that significantly influence life insurance and assessing the strength and direction of relationships.

This study uses annual data from 2013-2023 for the EU Member States, obtained from Eurostat (European Commission, 2024) and SwissRe (Sigma Research Reports, 2024). The variables used were: *life insurance density*, as premium per capita, *life insurance penetration*, as percentage of GDP, *unemployment rate*, as percentage of population, *GDP growth*, and *inflation.*

The research methodology is based on Bayesian Network Analysis, by applying both Gaussian Graphical Models (GGM) and Gaussian Causal Graphical Models (GCGM). The use of these graphical models provides a suitable tool for modeling and identifying the links between the specified indicators.

Table 1. Descriptive statistics of the variables used in the econometric model

Explanation	**GDP_growth**	**IP_life**	**ID_life**	**UEmp_rate**	**Inflation**
Valid	296	261	261	297	289
Missing	1	36	36	0	8
Mean	4.589	2.991	1389.637	5.217	1.790
Standard deviation	9.684	2.438	1526.272	2.676	1.853
Minimum	-11.300	0.200	21.000	1.200	-1.600
Maximum	97.530	9.680	7917.000	17.300	8.100

Source: Author contribution in JASP, based on Eurostat (European Commission, 2024) and Swiss Re data (Sigma Research Reports, 2024)

The variables used in Table 1, as acronyms, refer to the following indicators:

- IP_life: Insurance penetration for life insurance market (% of GDP, data collected from SwissRe Institute, Sigma Research Report);

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- ID_life: Insurance density for life insurance market (USD/capita, data collected from SwissRe Institute, Sigma Research Report);
- UEmp_rate: Unemployment rate (% of population, data collected from Eurostat, European Commission);
- GDP_growth: Percentage of change in the real GDP per capita between two consecutive years (%, change over the previous years, based on seasonally adjusted data, data collected from Eurostat);
- Inflation: The rate at which the general level of prices is rising (%, change in prices compared to the previous year, data collected from Eurostat);

4. Results and discussions

The analysis and interpretation of the results obtained provides valuable information on the relationship between economic uncertainty and life insurance indicators in the EU Member States. By applying graphical modeling techniques, this research contributes to a deeper understanding of the factors that influence financial behavior and inform political and business decisions in the life insurance industry.

The analysis based on Bayesian Network Analysis reveals some notable findings regarding the complex links between *inflation*, *unemployment rate* (UEmp_rate), *GDP growth rate* (GDP_growth), *life insurance penetration* (IP_life) and life *insurance density* (ID_life).

Inflation, unemployment (UEmp_rate), and GDP growth are key macroeconomic indicators that reflect the health and performance of an economy. Insurance penetration and density, on the other hand, measure the degree of insurance coverage within a population and, respectively, the financial volume of premiums in relation to GDP.

Understanding the relationships between these variables can provide valuable insights into economic stability, societal resilience, and the role of the insurance industry in mitigating financial risks (Cristea, Marcu, Cârstina, 2014).

The results obtained in **Fig. 1.** indicate that inflation (Inflation) has a direct positive link with unemployment (UEmp_rate) – but unfavorable, since inflation increasing generates also an increase of unemployment, and a negative association with insurance indicators. These findings are consistent with previous studies (Ferezagia, 2020), highlighting the negative impact of inflation on the stability of the insurance market.

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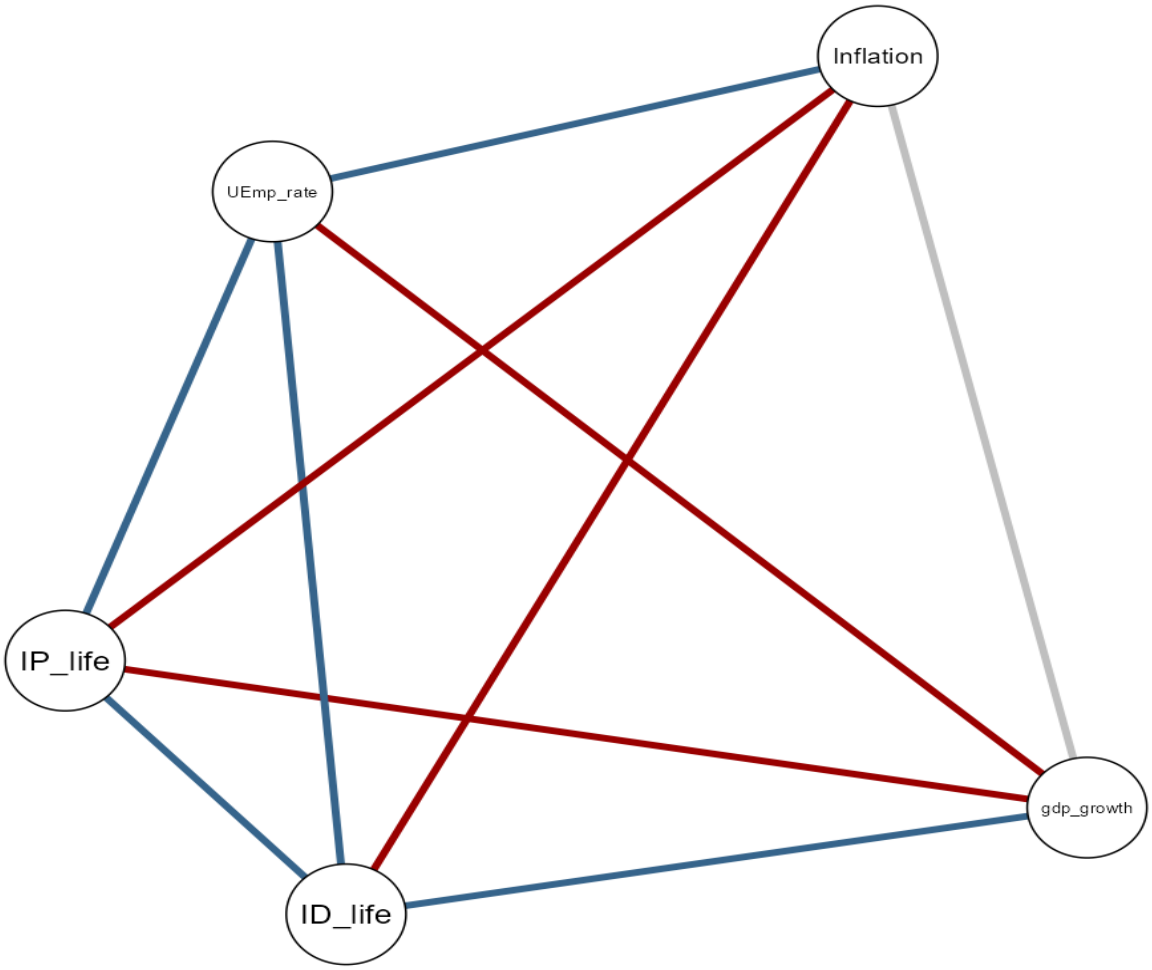
In addition, a direct relationship has been identified between unemployment (UEmp_rate) and life insurance indicators (ID_life and IP_life), implying that rising unemployment rates are increasing demand for life insurance products. This relationship implies that during times of higher unemployment, there is an increased demand for insurance products, possibly due to increased financial insecurity and the need to mitigate risks. This observation is in line with the studies conducted by Buric et al. (2017) and Cristea and Danciulescu (2016), which report similar trends in the impact of unemployment on life insurance demand, respectively total insurance market.

Fig. 1. Bayesian Network Analysis results by applying the GGM, 2013–2023



Source: Author contribution in JASP, based on Eurostat (European Commission, 2024) and Swiss Re data (Sigma Research Reports, 2024)

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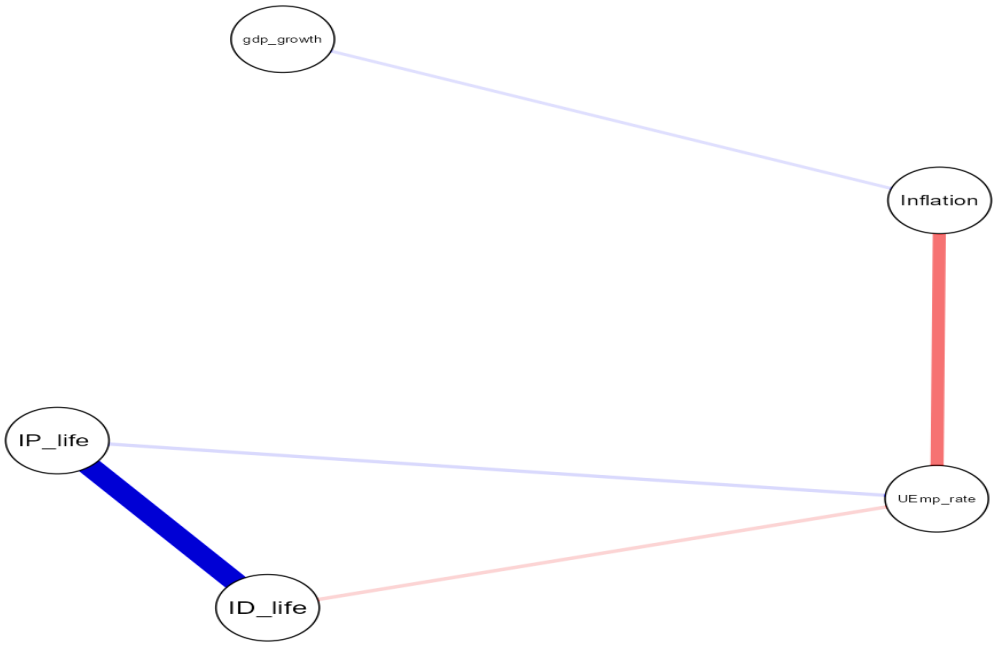
Robust GDP growth is associated with higher insurance density, indicating that a healthy economy stimulates the insurance market, as noted in the findings of Lee, Lee and Chiu (2013) and Cristea, Marcu,Cârstina (2014), who highlight the role of GDP growth, respectively GDP per capita, in promoting economic stability and expanding demand in the insurance market.

It can be seen that life insurance penetration (IP_life) and life insurance density (ID_life) are closely related to each other, as expected. Higher insurance penetration, indicating wider coverage of insurance services, is associated with higher insurance density, reflecting higher premium volumes relative to GDP.

Moreover, in terms of the results obtained by applying the GCGM graphical models **(Fig. 2.)**, the positive dependence between rising unemployment rates and life insurance penetration highlights the fact that EU Member States' economies, even though they face volatility, the vast majority of life insurance markets are stable, in line with the findings of Cummins, Rubio-Misas and Vencappa (2017) on the increase in insurance.

Fig. 2. Bayesian Network Analysis results by applying the GCGM, 2013–2023



Source: Author contribution in JASP, based on Eurostat (European Commission, 2024) and Swiss Re data (Sigma Research Reports, 2024)

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The negative dependence between unemployment and insurance density indicates that higher unemployment rates are associated with lower insurance density, reflecting economic pressure on consumers, as noted in Napier (2015) research on macroeconomic variables and insurance demand. Moreover, the strong positive link between life insurance penetration and density is in line with existing research on these indicators, both measuring the development of the insurance sector.

Also, it can be specified that the results of the analysis underline the close link between the economic development of EU member states and the insurance sector, providing valuable information that is in line with the existing literature on the subject (Cristea et al., 2021).

While the results confirm previous research on the direct effects of inflation, the increase in unemployment and GDP growth on insurance indicators, it provides new insights into the indirect effects of macroeconomic indicators on EU member states stability.

5. Conclusions and discussions

The article addresses the complex relationship between economic uncertainty and life insurance demand, highlighting some key findings. The analysis underlines the multidimensional nature of economic interdependencies and emphasizes the need for integrated analysis in understanding the complex interactions between economic conditions and insurance indicators. By uncovering direct and indirect dependencies, the results contribute to a more comprehensive understanding of how economic fluctuations influence the insurance market.

Thus, it demonstrates that increased economic uncertainty, characterized by fluctuations in inflation and unemployment rates, influences people's financial behavior, leading to an increased demand for life insurance as a means of mitigating financial risks. Looking ahead, future research could explore the multidimensional effects of economic uncertainty on life insurance adoption.

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